

NOTES ON THE OCCURRENCE AND DISTRIBUTION OF *PTERONARCYS CALIFORNICA* NEWPORT (PLECOPTERA) WITHIN STREAMS

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ABSTRACT.— During a physiological study that required the collection of several thousand stoneflies, *Pteronarcys californica*, observations were made on the distribution of these aquatic insects within streams. It was noted that *P. californica* occur primarily in large rivers that have loose, unconsolidated substrates and swift currents. They occur from depths of six inches to several feet. They are exclusively vegetarian, feeding on detritus, algae, and diatoms. *P. californica* congregate in dense clumps, but within the clumps they segregate by size. The largest specimens are found in the quietest water. There is evidence of some seasonal variation in their behavior.

Pteronarcys californica is a large stonefly (Order Plecoptera) of the mountain and Pacific west. Because of its large size (often in excess of one gram) and its hardness compared to other stoneflies, it is an ideal organism to use in physiological studies.

During one such study, observations were made on the occurrence and distribution of this species within river systems. The study required several thousand of these large insects, and collections were made throughout the year. Most of the observations were made in Utah in the lower Provo River below Deer Creek Reservoir. The section containing *Pteronarcys californica* was entirely within Utah County from the immediate vicinity of Vivian Park to the mouth of Provo Canyon. Residents in the area reported that *Pteronarcys californica* had at one time existed close to Deer Creek Reservoir but had been replaced by the smaller *Pteronarcella badia* in recent years. Upon investigation of the tailwater at this point, it was discovered that the fauna and flora had the appearance of a stressed environment. The algae were long, filamentous greens, and the most common invertebrate was an amphipod (many times more common than any other organism). This led us to the conclusion that there was at least one period during the year when poorly oxygenated water was discharged from Deer Creek Reservoir. Apparently *Pteronarcella* can outcompete *Pteronarcys* in this type of stress.

Other rivers where we collected *Pteronarcys californica*, to a limited extent, were the Bear River upstream from Evanston, Wyoming, Uintah County, to near the Utah border; North Fork, Teton River, Idaho, at Idaho 32 bridge, Teton County; and Henry's Fork, Idaho, near the U.S. 20, 191 bridge near Ashton in Fremont County.

Claassen (1931) states that *Pteronarcys* universally inhabits "small, cold, upland spring brooks." This is not true of *Pteronarcys californica*. It inhabits the larger rivers of the west that have large volumes of water throughout the year. Man's alteration of the habi-

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tat can adversely affect its distribution. *Pteronarcys californica* once was numerous on the Gunnison River, Colorado (Knight, 1965), prior to the construction of several dams. In 1972 when we visited the river, *Pteronarcys californica* had not only disappeared below the reservoirs but was very rare above them. Why this has occurred is not known.

Usually *Pteronarcys californica* occurs in dense clumps in larger streams. Occasionally, a few scattered individuals can be found, but stream drift is probably responsible for this. They do not seem to exhibit any drifting behavioral patterns, but in our holding tanks *Pteronarcys californica* were nocturnally active. Heaton (1966) found a 22:1 night-day drift ratio for this species. It is possible that *Pteronarcys californica* drift at night. Their typical behavior when dropped into flowing water or when dislodged from the substrate is to "ball up" and drop to the bottom.

Large populations of *Pteronarcys californica* are typically found in swift water but rarely in "white" water. We have found them in depths ranging from six inches to three feet, and they probably occur deeper. The rocks are notably free of large clumps of algae, and the bottom of rooted aquatics. Loose, unconsolidated bottoms seem to be preferred, with the minimum size of stones approximately six inches and maximum size unknown. In Henry's Fork we collected in excess of 100 individuals from one rock of approximately three feet in diameter.

Pteronarcys californica seem to prefer loose rock where terrestrially derived detritus collects, or rocks with a coating of diatoms and other small green algae. Richardson (1965) reported that *Pteronarcys californica* is a detritus feeder. Our analysis of gut contents from more than 1000 individuals has not revealed a single case of carnivorous feeding.

Pteronarcys californica nymphs tend to segregate by size (size is determined by age and sex). The aquatic stage of this species lasts three years. In a single stretch of water on the Provo River at Vivian Park, third-year females, the largest size, were found farthest upstream in the calmer water with the largest rubble. *Pteronarcys californica* density was the lowest in this type habitat. Downstream, as the depth decreased, the rubble became smaller and looser, and the organisms became smaller and more numerous. Here, while measurements were not made, it appeared that second-year females were mixed with second- and third-year males. First-year specimens were found commonly with the second-year females and second- and third-year males but were most common in areas lacking the larger classes. In the coldest winter months, when the rivers were lowest, there was some indication that the size segregation partially broke down. This was probably due to lack of available habitat.

During the spring, May-July, when *Pteronarcys californica* emerge, the rivers rise to such an extent that sampling is virtually impossible. However, it has been noted by Gaufin that the emerging insects migrate to shallow water, where the rocks are partially ex-

posed. Here they congregate and wait for the cue to emerge. Emergence is accomplished by crawling out of the water onto a rock or shore, splitting the nymphal exoskeleton, and emerging as an adult.

On most rivers where we collected, *Pteronarcys californica*, when found, was extremely abundant, but in very limited areas of one hundred meters or less. On the Henry's Fork, *Pteronarcys californica* was much more abundant than elsewhere we collected. Nevertheless, in any given riffle, a sample of approximately one meter square might yield more than 100 organisms, while only a few meters away on rubble that was superficially identical an area of similar size might yield few, if any, individuals.

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